

REMARKS

All references to "Office Action" below are in reference to the Office Action dated February 14, 2000. In the Office Action, claims 1-41 were indicated as pending in the present application. Claims 1-27 were withdrawn from consideration. Claims 28-41 were rejected. By this Amendment, claims 30, 32, 36, and 40 were cancelled. New claim 42 was added. Thus, claims 1-29, 31, 33-35, 37-39, and 41-42 are now pending in the present application. The rejections set forth in the Office Action are respectfully traversed below.

The Drawings:

The drawings, as well as the specification, were objected to under 37 CFR 1.83(a) as failing to show the principle of the present invention.

It was confirmed that Figs. 3 and 4 contained an error, and corrections thereto are indicated in red ink in the concurrently filed Request for Approval of Drawing Corrections. In attached Figs. 3 and 4, please note that "N₂O" was changed to --H₂O--. Accordingly, item A on page 3 of the Office Action has been overcome.

In view of the objection B on page 3 of the Office Action, with regard to the terms Q and Pm in Figs. 3 - 13, it is submitted that Q and Pm respectively represent the partial pressure of H₂O and OH released from the insulation film in terms of Torr.

With regard to the alleged inconsistency of electrical powers in Figs. 9 - 12 addressed on page 3, item C of the Office Action, it was noted that this inconsistency arose from a typographic

error in the specification, page 16, line 29, wherein "Fig. 5" should have been --Fig. 4--. With the above amendment to the specification, item C of page 3 and item B on page 4 are overcome.

With regard to item D on page 3 of the specification, although Figs. 3 - 13 appear to contain unnecessary lines for disclosure of the invention, the drawings do contain the illustration of H₂O and OH release from the insulation film. Thus, it is submitted that Figs. 3-13 provide adequate support of the invention.

The Summary of the Invention:

Items 4-7 on pages 3-5 of the Office Action are all directed to alleged deficiencies in the Summary of the Invention section of the present specification.

For instance, at item 4 on pages 3-4 of the Office Action, the Examiner alleged that "claims are written in legal language to specify in broad terms the legal limitations of the invention, and are not intended to provide technical information to the public about the nature of the invention." This is incorrect and contradicts well established U.S. patent law. Although claims are subject to legal interpretation, the language of the claims are still descriptive of the invention and serves to inform the public of the nature of the invention in a clear and concise manner. It is well established U.S. patent law that even the originally filed claims may constitute a source for written description and enablement support of the invention.

At item 5 on page 4 of the Office Action, the Examiner referred to the first paragraph of 35 USC §112 and then concluded that "the legal language utilized for claims to set the meets and

bounds of the patent protection does not fulfill this requirement". This is incorrect. It is well established U.S. patent law that the language of originally filed claims contribute to the written description and enablement requirements under 35 USC §112, first paragraph.

At item 5 on page 4 of the Office Action, the Examiner further alleged that "since the Summary of the Invention merely duplicates the claims, it is not providing support for the claims". There are numerous errors in this misstatement. First, support for the claims come from the application as a whole, including the detailed description of the invention section of the specification. Second, antecedent support for claim language is supported by using the same language in the specification, including use of the same language in the Summary of the Invention section.

At item 6 on pages 4-5 of the Office Action, the Examiner referred to 35 USC §112, second paragraph and then concluded by alleging "since the claims are given at the end of the specification, it is redundant and superfluous to include them as part of the summary." This conclusion does **not** follow from the requirements of 35 USC §112, second paragraph. There is no requirement under U.S. Patent Law that forbids an applicant from using claim language in the Summary of the Invention section of the specification.

At item 7 on page 5 of the Office Action, the Examiner referred to USPTO rules identifying a Summary of the Invention Section and a Claims section for an application, and then concluded by saying "the intended objective was not to provide an exact copy of the claims in the

summary". However, there is no rule nor statute prohibiting an applicant from repeating language of a claim in the Summary of the Invention section of the specification.

It is submitted that the present Summary of the Invention section meets all the requirements under U.S. patent law and under USPTO rules.

It should also be emphasized that the Summary of the Invention section is not merely an exact copy of the claims, as the Examiner repeatedly alleged. The Office Action ignored concise and pertinent descriptions of the invention in the Summary section. For example, page 6, line 31 to page 7, line 9; page 9, lines 5-17; page 10, lines 20-27; and page 13, lines 12-23 are not duplications of claim language and sufficiently inform the public of the nature of the invention, in conjunction with the other descriptions in the Summary section of the specification. No corrections to the Summary section are necessary.

Rejections Under 35 USC §112, First Paragraph:

Claim 30 was rejected under 35 USC §112, first paragraph, as being non-enabling. Claim 30 was cancelled above without prejudice or disclaimer of the subject matter recited therein. Thus, the rejection under 35 USC §112, first paragraph is deemed moot.

Rejections Under 35 USC §112, Second Paragraph:

Claims 32, 33, 36, 37, 40 and 41 were rejected under 35 USC §112, second paragraph. Claims 33, 37, 39, and 41 were amended above to overcome these rejections. Claims 32, 36 and 40 were cancelled without prejudice or disclaimer of the subject matter recited therein.

Claims 31, 35 and 39 were rejected under 35 USC §112, second paragraph. Claims 31, 35, and 39 were amended above to overcome these rejections.

Rejections Under 35 USC §103:

Claims 28, 29, and 31 were rejected under 35 USC 103(a) as being unpatentable over Applicant's Admitted Prior Art in view of Toyotaka.

It should be noted that the present invention addresses the problem of trapping of OH in a gate oxide film in a semiconductor device of the SAC (self-aligned contact hole) type, carrying a silicide region on a shallow junction for high-speed operation. As explained in the specification, a SAC structure requires an etching stopper film of S102 (first insulation film) under an etching stopper film of SiN (second insulation film) in order to eliminate the damaging of the shallow junction region at the time of a dry etching process of the SiN film. In the SAC type device of the present invention, such as SiO₂ etching stopper film has to be formed at a low temperature in view of the use of the shallow junction and in view of the existence of the silicide region on the shallow junction.

During the investigation of the foregoing SAC type device, the inventor of the present invention has discovered the foregoing, unexpected problem in that the gate oxide film tends to trap OH ions and identified that the OH ions are originated from H₂O molecules released from the low temperature SiO₂ film (first insulation film) covering the first insulation film very effectively blocks the escape of the H₂O molecules thus released from the first insulation film.

Thus, the present invention eliminates the problem of OH trapping in the gate oxide film, in a SAC-type semiconductor device having a SAC on a diffusion region and a silicide region formed on the diffusion region that acts as a shallow-junction, by reducing the H₂O content in the SiO₂ etching stopper (first insulation film) as taught in amended claim 28. The inventor of the present invention has discovered that the effect of H₂O release from the first insulation film is suppressed substantially when the H₂O content in the first insulation film is less than about 2.4 wt%.

Contrary to the present invention, Toyotaka merely discloses a semiconductor device having a SALICIDE (self-aligned silicide) structure. Thus, Toyotaka entirely fails to teach the feature of SAC, nor the feature of the H₂O content in the first insulation film of the SAC structure. In the absence of the knowledge about the OH trapping caused by the H₂O molecules released from the first insulation film, a person skilled in the art would never be motivated to set the H₂O content in the first insulation film as set forth in amended claim 28.

It should be noted that the structure of Fig. 2 per se is known and constitutes Prior art, but the effect of the H₂O molecules thus released from the first insulation film causing an OH trapping

in the gate oxide film, or the effect of the H₂O confinement by the first insulation film, was first discovered by the inventor of the present invention.

For at least these reasons, the present claimed invention patentably distinguishes over the present application.

As claim 28 is thus distinct over the prior art, claims dependent therefrom are deemed also distinct over the prior art.

Claim 34 was rejected under 35 USC §103(a) as being unpatentable over Applicant's admitted Prior Art in view of Wolf. It is submitted that Wolf merely discloses the technique of BPSG and is not related at all to the gettering of H₂O by way of B or P. Thus, there is absolutely no motivation to combine the references. It is submitted that the subject matter of amended claim 34 is by no means derived from the combination of Applicant's admitted Prior Art and Wolf.

As claim 34 is thus distinct over the prior art, claims dependent therefrom are also deemed distinct over the prior art.

Claim 38 was rejected similarly to claim 34. It is submitted that claim 38 distinguishes over the prior art for at least the same reasons claim 34 distinguishes over the prior art, as discussed above. As claim 38 is thus distinct over the prior art, claims dependent therefrom are deemed distinct over the prior art.

Independent claims 28, 34, and 38, were amended to clarify that the subject device is a SAC-type device carrying a silicide region on the diffusion region. Claims 32, 36 and 40 were cancelled without prejudice or disclaimer of the subject matter recited therein.

While new independent claim 42 was added, it is noted that it may be withdrawn from consideration since it is directed to a method of making a semiconductor device - which is non-elected subject matter in view of the restriction requirement dated September 28, 1999 and the Applicant's response thereto dated October 13, 1999.

Summary

It is submitted that nothing in the prior art, either alone or in combination, teaches or suggests all the features recited in the present claimed invention. Reconsideration of pending claims 28, 29, 31, 33-35, 37-39, and 41-42, and an Early Notice of Allowance are earnestly solicited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE.**"

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney, at the telephone number indicated below, to arrange for an interview to expedite the disposition of this case.

U.S. Serial No. 09/045,118
Kousuke SUZUKI, et al.

Attorney Docket No. 980268

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosures: Request for Approval of Drawing Corrections for Figs. 3, 4, and 16
Version with Markings to Show Changes Made

JPK:sdj

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IN THE SPECIFICATION:

Paragraph beginning at page 16, line 27, has been amended as follows:

--FIG. 9 shows a differential in which the result of FIG. 3 is subtracted from the result of [FIG. 5] FIG. 4. As already explained with reference to FIG. 4, the SO₂ film deposited under the plasma power of 2000W contains a large amount of H₂O and OH.--

Paragraph beginning at page 17, line 2, has been amended as follows:

--Further, FIG. 11 shows a differential in which the result of FIG. 3 is subtracted from the result of FIG. 6 in which the high-frequency power is set to 50W. As can be seen clearly from [FIG. 10] FIG. 11, the amount of H₂O and OH released from the SiO₂ film is deposited under the high-frequency power of 50W is reduced further as compared with the case of FIG. 10.--

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Paragraph beginning at page 17, line 9, has been amended as follows:

--Further, FIG. 12 shows a differential in which the result of FIG. 3 is subtracted from the result of FIG. 7 in which the deposited SiO₂ film has a refractive index of 1.5. In this case, the amount of release of H₂O and OH is reduced further. In contrast, FIG. 13 shows the case in which the result of FIG. 3 is subtracted from the result of [FIG. 10] FIG. 9 in which the deposited SiO₂ film has a refractive index of 1.63. In this case, the amount of H₂O and OH incorporated into the SiO₂ film starts to increase again.--

IN THE CLAIMS:

Claims 30, 32, 36 and 40 have been canceled.

Claims 28, 31, 33-35, 37-39 and 41 have been amended as follows:

28. (Amended) A semiconductor device, comprising:

a substrate;

a gate electrode provided on said substrate;

a diffusion region formed in said substrate adjacent to said gate electrode;

a side-wall insulation film formed on a side wall of said gate electrode; [and]

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a self-aligned contact hole defined by said side-wall oxide film and exposing said diffusion region; and

a silicide region formed selectively on a surface of said diffusion region;

wherein said semiconductor device further includes;

a first insulation film provided on said gate electrode so as to cover said side wall oxide film partially;

a second insulation film having a composition different from a composition of said first insulation film and provided on said first insulation film;

an interlayer insulation film deposited on said second insulation film;

a contact hole formed in said interlayer insulation film, said contact hole extending through said first and second insulation films and exposing said self-aligned contact hole;

said first insulation film contacts H₂O with an amount smaller than about 2.4 wt%.

31. (Amended) A semiconductor device as claimed in claim 28, further comprising a conductor pattern contacting with said diffusion region and said gate electrode such that said conductor pattern extends [between said side wall oxide film and said first insulation film] along a surface of said side wall oxide film.

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33. (Amended) A semiconductor device as claimed in claim [32] 28, further comprising [a] another silicide [layer] region formed selectively on a surface of said gate electrode.

34. (Amended) A semiconductor device, comprising:
a substrate;
a gate electrode provided on said substrate;
a diffusion region formed in said substrate adjacent to said gate electrode;
a side-wall insulation film formed on side wall of said gate electrode; [and]
a self-aligned contact hole defined by said side-wall oxide film and exposing said diffusion region; and

a silicide region formed selectively on a surface of said diffusion region,

wherein said semiconductor device further includes:

a first insulation film provided on said gate electrode so as to cover said side wall oxide film partially;

a second insulation film having a composition different from a composition of said first insulation film and provided on said first insulation film;

an interlayer insulation film deposited on said second insulation film;

a contact hole formed in said interlayer insulation film, said contact hole extending through said first and second insulation films and exposing said self-aligned contact hole;

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said first insulation film is formed of PSG containing P with an amount of about 6 wt% or less.

35. (Amended) A semiconductor device as claimed in claim 34, further comprising a conductor pattern contacting with said diffusion region and said gate electrode such that said conductor pattern extends [between said side wall oxide film and said first insulation film] along a surface of said side wall oxide film.

37. (Amended) A semiconductor device as claimed in claim [36] 34, further comprising [a] another silicide [layer] region formed selectively on a surface of said gate electrode.

38. (Amended) A semiconductor device, comprising:

- a substrate;
- a gate electrode provided on said substrate;
- a diffusion region formed in said substrate adjacent to said gate electrode;
- a side-wall insulation film formed on a side wall of said gate electrode; [and]
- a self-aligned contact hole defined by said side-wall oxide film and exposing said diffusion region; and
- a silicide region formed selectively on a surface of said diffusion region,

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wherein said semiconductor device further includes:

a first insulation film provided on said gate electrode so as to cover said side wall oxide film partially;

a second insulation film having a composition different from a composition of said first insulation film and provided on said first insulation film;

an interlayer insulation film deposited on said second insulation film;

a contact hole formed in said interlayer insulation film, said contact hole extending through said first and second insulation films and exposing said self-aligned contact hole;

said first insulation film is formed of BPSG containing B with an amount of about 4 wt% or less.

39. (Amended) A semiconductor device as claimed in claim 38, further comprising a conductor pattern contacting with said diffusion region and said gate electrode such that said conductor pattern extends [between said side wall oxide film and said first insulation film] along a surface of said side wall oxide film.

41. (Amended) A semiconductor device as claimed in claim [40] 38, further comprising [a] another silicide [layer] region formed selectively on a surface of said electrode.

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Claim 42 has been added as follows:

- 42. A method of fabricating a semiconductor device, comprising the steps of:
- (A) forming a refractory metal layer on a diffusion region in a semiconductor substrate;
 - (B) forming a self-aligned silicide layer on said refractory metal layer by applying a heat-treatment process;
 - (C) forming an insulation film on a surface of said silicide layer by conducting a plasma CVD process while using a source gas containing SiH_4 and N_2O with a ratio of N_2O with respect to SiH_4 equal to or less than 5;
 - (D) forming a nitride film, after said step (C), on said insulation film in contact with said insulation film, without exposing a surface of said insulation film to the air;
 - (E) forming an interlayer insulation film so as to cover said nitride film; and
 - (F) forming a window exposing said silicide layer, by applying a dry etching process consecutively to said interlayer insulation film, said nitride film, and said insulation film.--